HTTP Live Streaming Introduction

Session 313

These are confidential sessions—please refrain from streaming, blogging, or taking pictures.

HTTP Live Streaming Introduction

Roger Pantos
QuickTime Engineering

Introduction

- iPhone has always supported network playback
  - Progressive download
  - Podcasts
  - YouTube
- But what about live content?

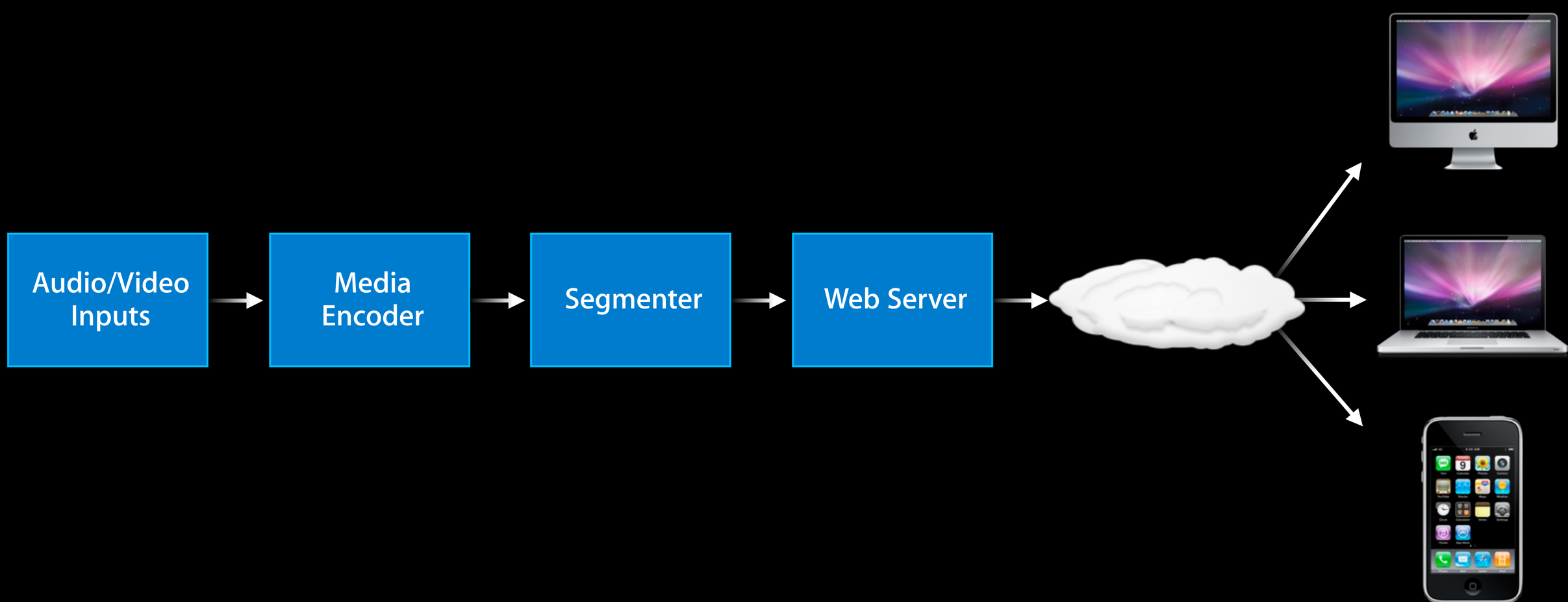
Goals

- Playback of live media
- Highly scalable
- Cost effective
- Pass through firewalls and NATs
- Easy to adopt, interoperable
  - Leverage existing standards

Use HTTP for Delivery

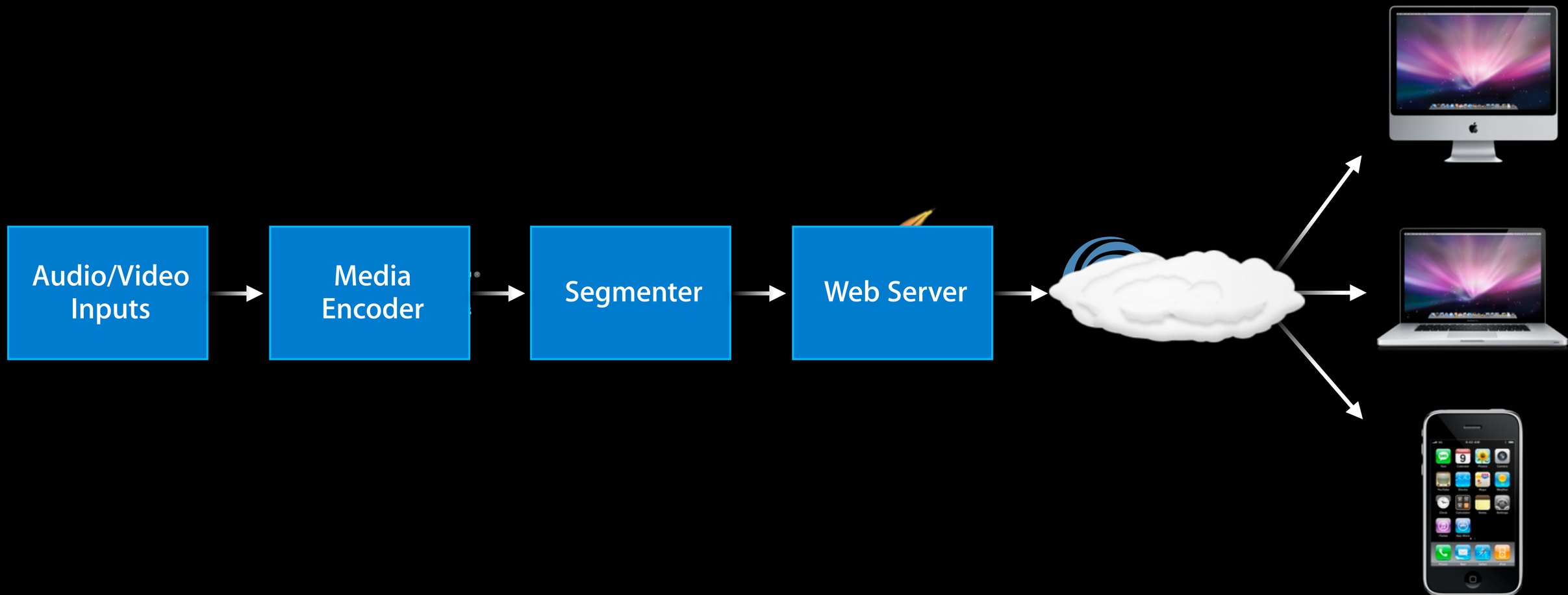
- Widely deployed, well-supported
- Proven scaling techniques
  - Load-balancing
  - Caching proxies help offload traffic
  - Content Delivery Networks (CDNs)
- Passes through firewalls, NAT-friendly

Architecture



Demo

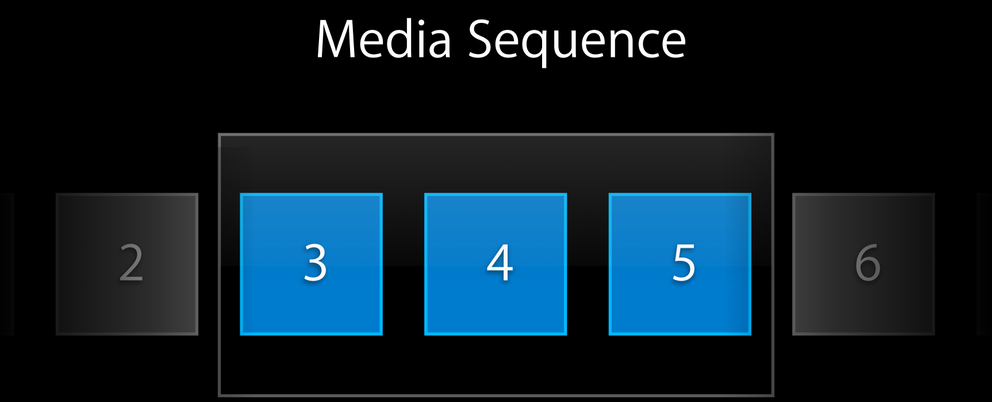
Demo Anatomy



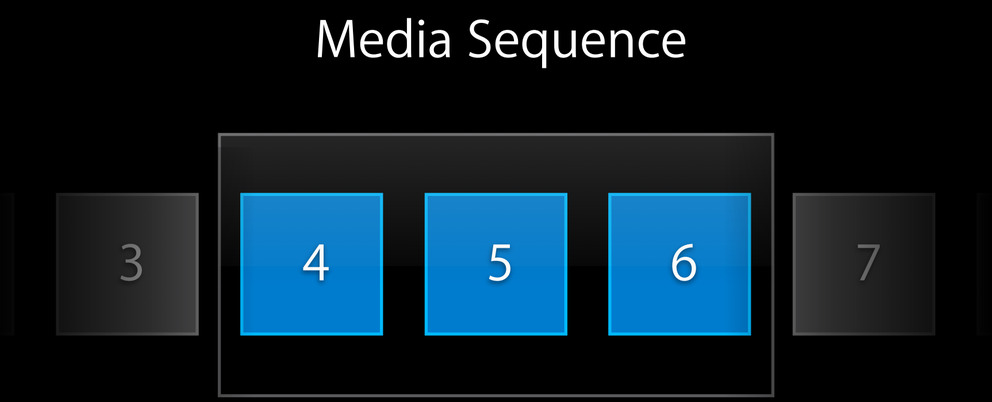
How It Works

- Server converts continuous stream into segment files
- Creates a playlist listing available segment files
- Client loads playlist, loads and plays segment files
- Client periodically reloads playlist

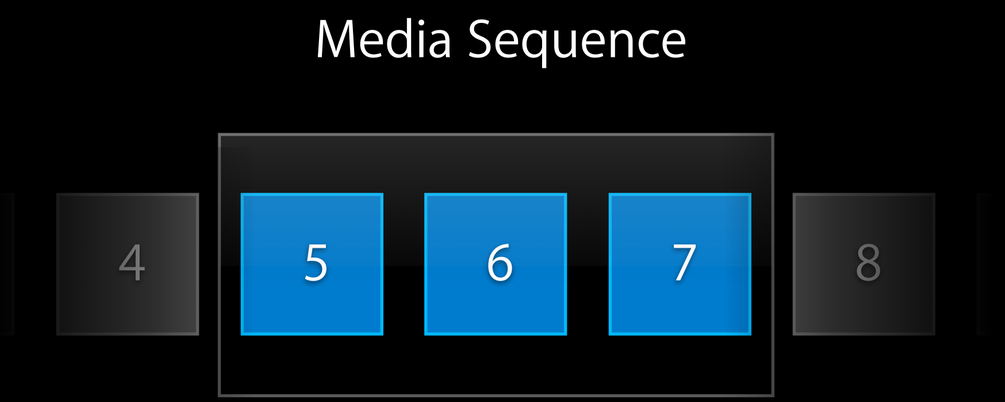
Playlist File



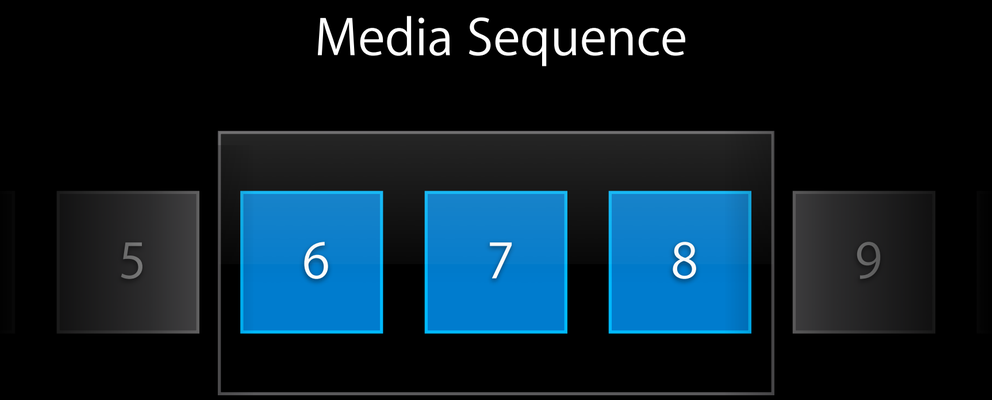
Playlist File



Playlist File

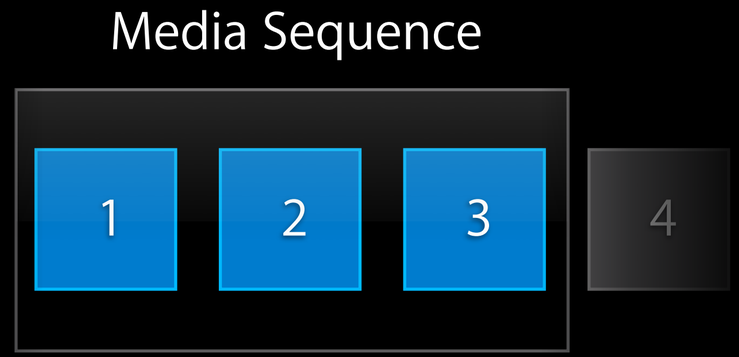


Playlist File



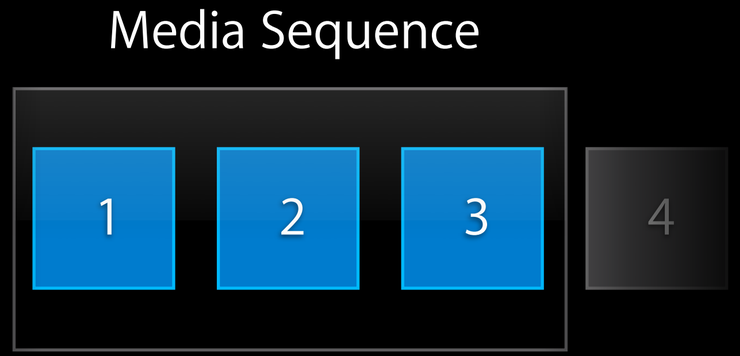
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:1
#EXTINF:10,
http://media.example.com/segment1.ts
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
```



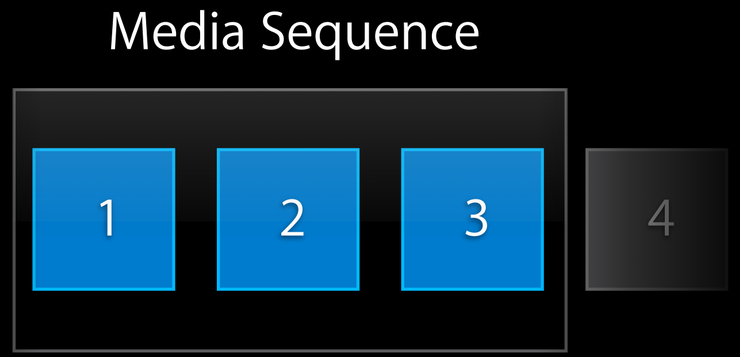
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:1
#EXTINF:10,
http://media.example.com/segment1.ts
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
```



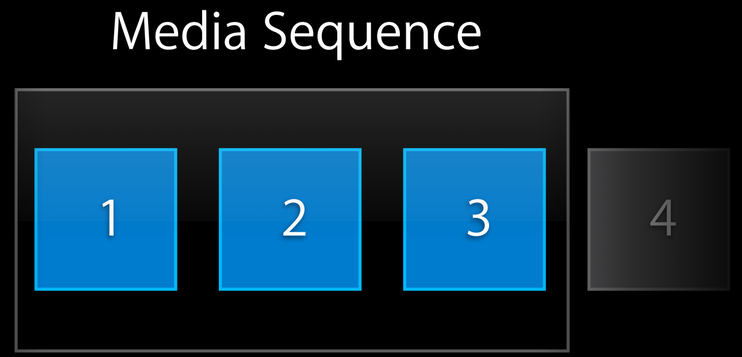
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:1
#EXTINF:10,
http://media.example.com/segment1.ts
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
```



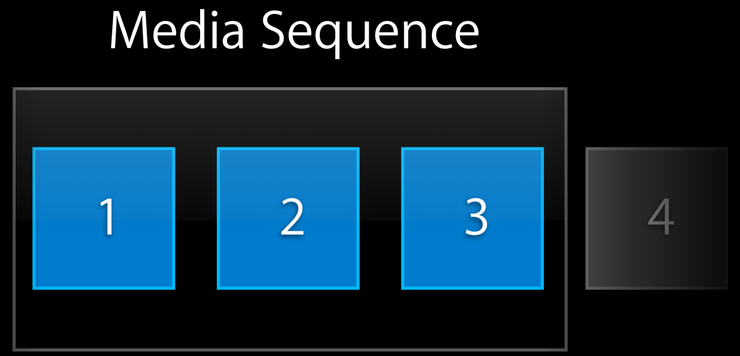
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:1
#EXTINF:10,
http://media.example.com/segment1.ts
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
```



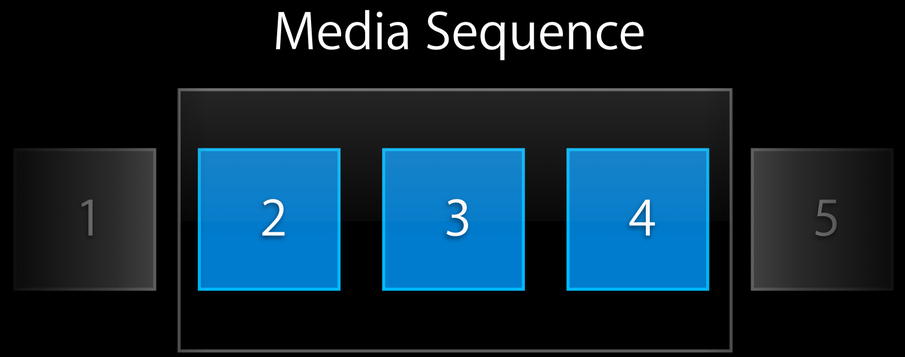
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:1
#EXTINF:10,
http://media.example.com/segment1.ts
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
```



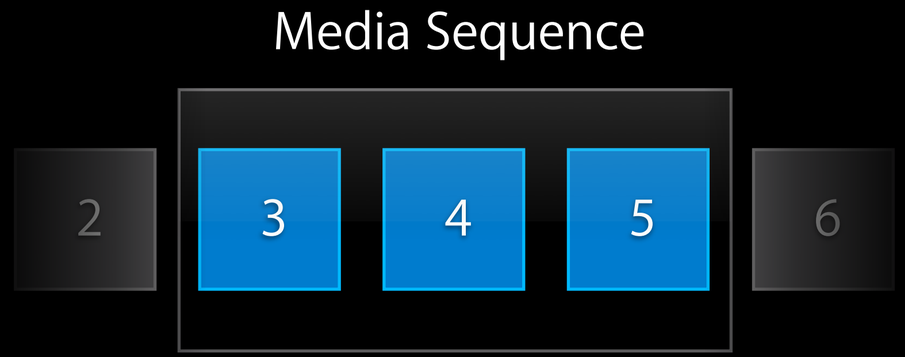
Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:2
#EXTINF:10,
http://media.example.com/segment2.ts
#EXTINF:10,
http://media.example.com/segment3.ts
#EXTINF:10,
http://media.example.com/segment4.ts
```



Sample Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:3
#EXTINF:10,
http://media.example.com/segment3.ts
#EXTINF:10,
http://media.example.com/segment4.ts
#EXTINF:10,
http://media.example.com/segment4.ts
```



Segment File Format

- MPEG-2 transport stream
- Elementary audio stream
  - ADTS
  - MPEG audio

Media Format

- Video
  - iPhone
    - H.264 Baseline Profile, Level 3.0
  - Desktop
    - H.264 up to High Profile, Level 4.0
- Audio
  - HE-AAC (version 1)
  - AAC-LC
  - MP3

iPhone OS Client API

- MediaPlayer framework
  - -[MPMoviePlayerController initWithContentURL:]
- Video tag in MobileSafari
  - <video src="http://example.com/stream.m3u8" />

Mac OS X Client API

- QTKit framework
  - -[QTMovie initWithAttributes:error:]
    - QTMovieOpenForPlaybackAttribute YES
    - QTMovieURLAttribute http://example.com/stream.m3u8

Beyond the Basics

- Encrypting media
- On-demand presentations
- Stream switching

Encrypting Media

- 128-bit AES encryption
  - Cipher Block Chaining
  - PKCS7 padding on segment boundaries
- Segments are encrypted before distribution
- Control key access using standard HTTP techniques
  - HTTPS
  - HTTP auth
  - Secure session cookie

Encrypted Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:39
#EXT-X-KEY:METHOD=AES-128,URI="https://example.com/1.key"
```

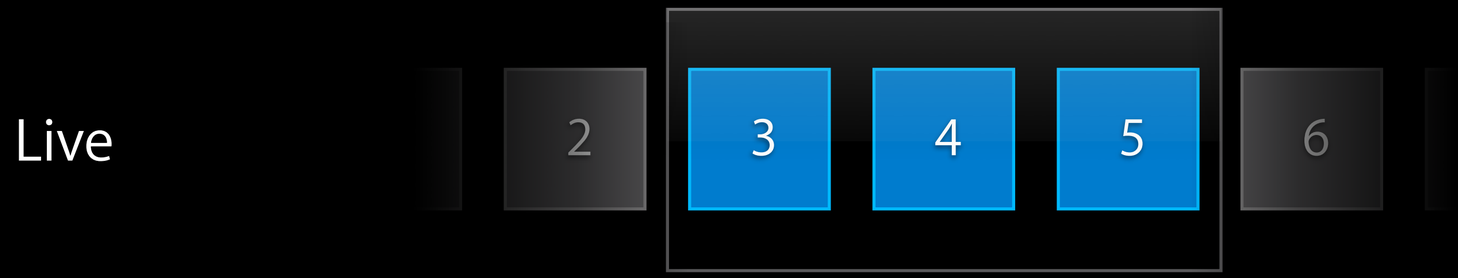
Encrypted Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:39
#EXT-X-KEY:METHOD=AES-128,URI="https://example.com/1.key"
#EXTINF:10,
http://media.example.com/segment39.ts
```

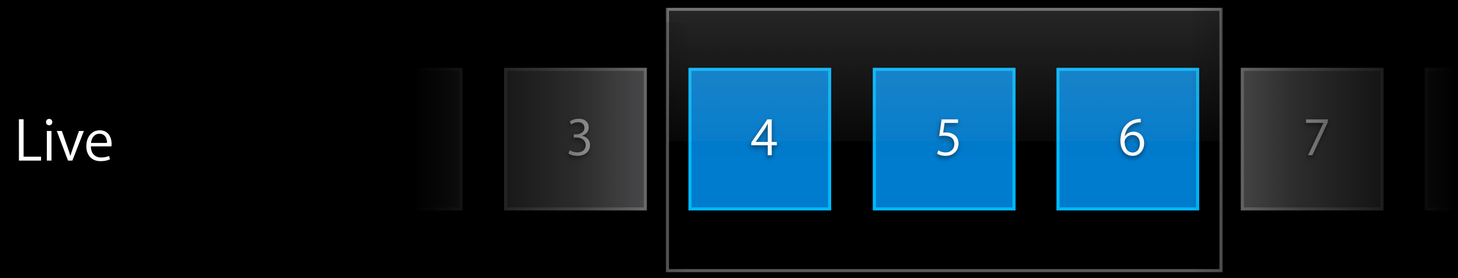
Encrypted Playlist

```
#EXTM3U
#EXT-X-TARGETDURATION:10
#EXT-X-MEDIA-SEQUENCE:39
#EXT-X-KEY:METHOD=AES-128,URI="https://example.com/1.key"
#EXTINF:10,
http://media.example.com/segment39.ts
#EXT-X-KEY:METHOD=AES-128,URI="https://example.com/2.key"
#EXTINF:10,
http://media.example.com/segment40.ts
```

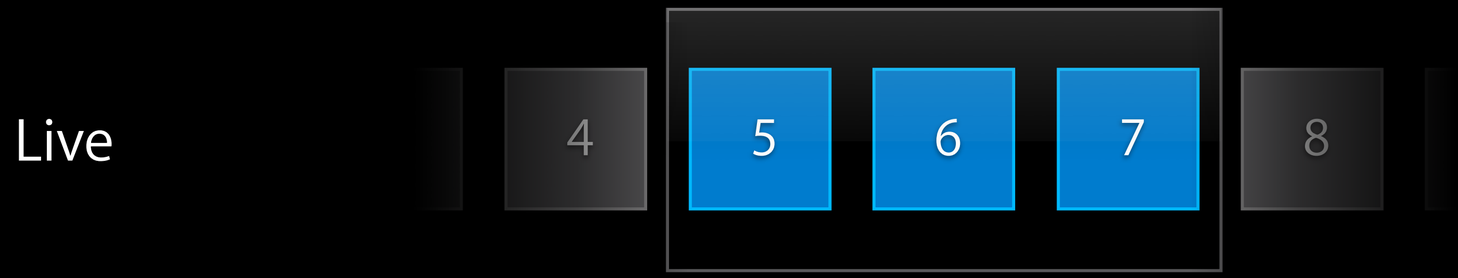
Live vs. On-demand Presentations



Live vs. On-demand Presentations



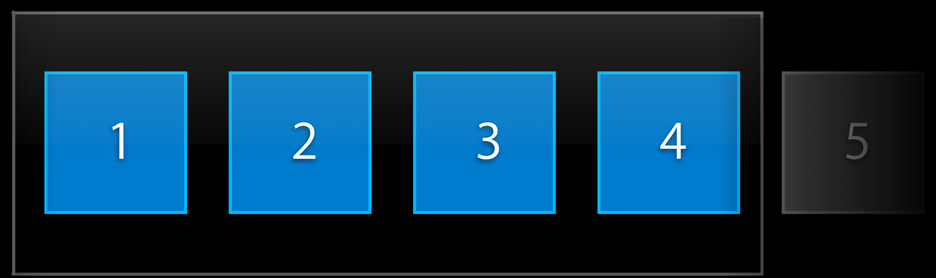
Live vs. On-demand Presentations



Live vs. On-demand Presentations

Live

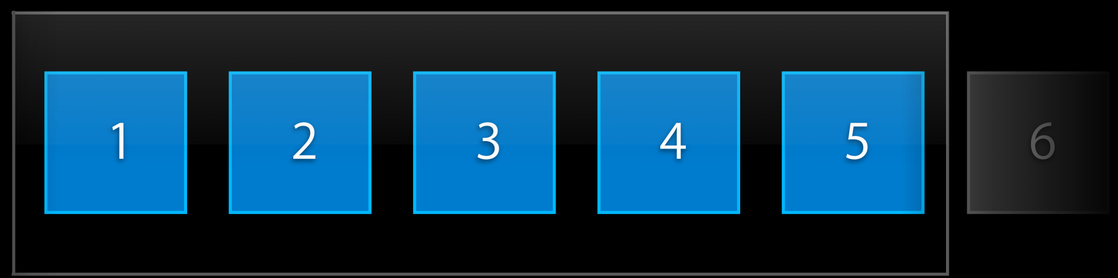
On-demand



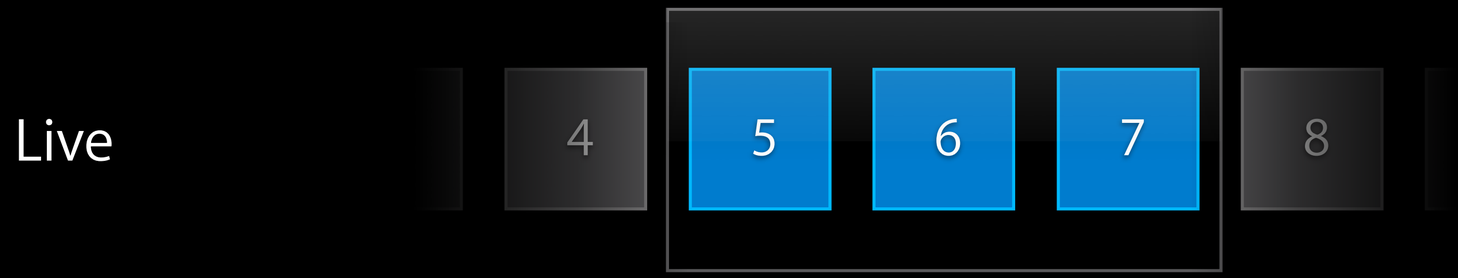
Live vs. On-demand Presentations

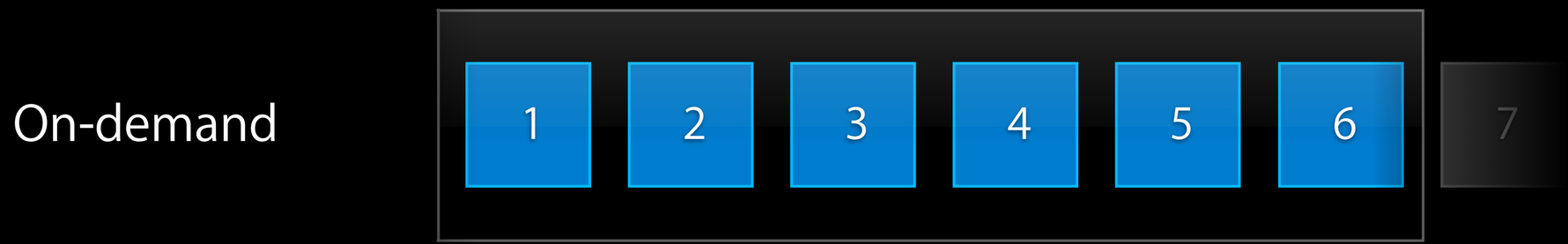
Live

On-demand

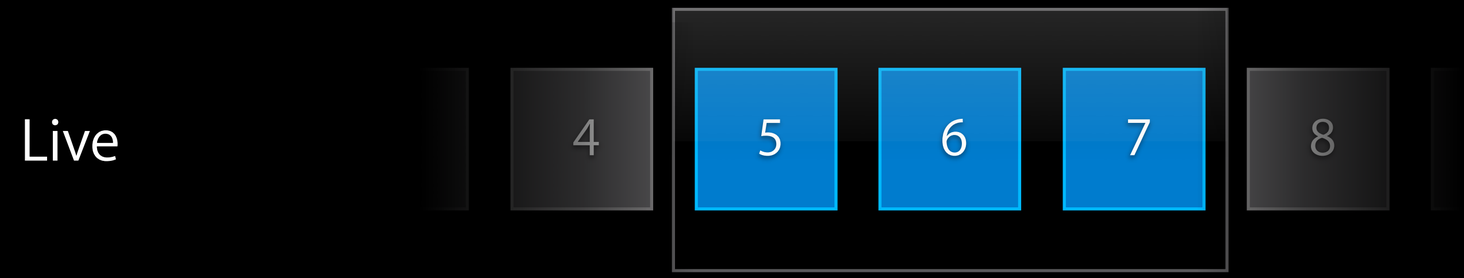


Live vs. On-demand Presentations





Live vs. On-demand Presentations



Live vs. On-demand Presentations

Live Playlist

```
#EXTM3U
#EXT-X-MEDIA-SEQUENCE:91
#EXT-X-TARGETDURATION:10
#EXTINF:10,
segment91.ts
#EXTINF:10,
segment92.ts
#EXTINF:10,
segment93.ts
```

Live vs. On-demand Presentations

Live Playlist

```
#EXTM3U
#EXT-X-MEDIA-SEQUENCE:92
#EXT-X-TARGETDURATION:10
#EXTINF:10,
segment92.ts
#EXTINF:10,
segment93.ts
#EXTINF:10,
segment94.ts
```

Live vs. On-demand Presentations

Live Playlist

```
#EXTM3U
#EXT-X-MEDIA-SEQUENCE:93
#EXT-X-TARGETDURATION:10
#EXTINF:10,
segment93.ts
#EXTINF:10,
segment94.ts
#EXTINF:10,
segment95.ts
```

Live vs. On-demand Presentations

Live Playlist

```
#EXTM3U
#EXT-X-MEDIA-SEQUENCE:93
#EXT-X-TARGETDURATION:10
#EXTINF:10,
segment93.ts
#EXTINF:10,
segment94.ts
#EXTINF:10,
segment95.ts
```

On-demand Playlist

```
#EXTM3U
#EXT-X-MEDIA-SEQUENCE:0
#EXT-X-TARGETDURATION:10
#EXTINF:10,
segment0.ts
#EXTINF:10,
segment1.ts
...
#EXTINF:10,
segment1130.ts
#EXT-X-ENDLIST
```

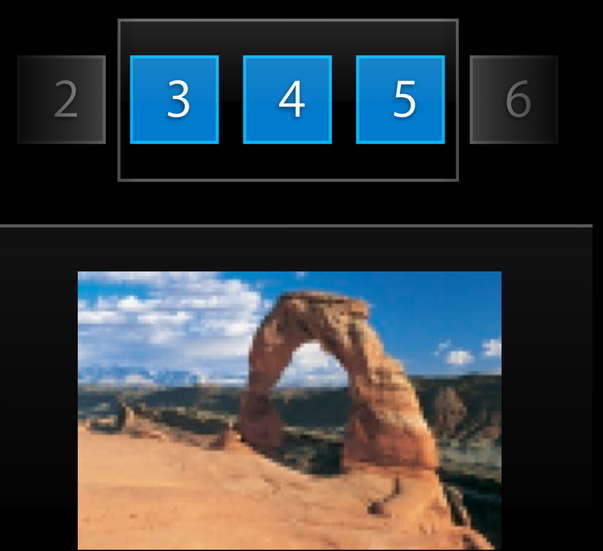
Network Variability

- Bandwidth changes constantly
- For live content, it's important to keep up

Stream Switching

- Variant playlist provides choice of streams
  - Variant can have different bit rate, codecs
- Client will switch to most appropriate variant
- Player is tuned for uninterrupted playback

Variant Playlist



Example Variant Playlist

```
#EXTM3U
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=128000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=256000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=768000
http://example.com/hi.m3u8
```

Example Variant Playlist

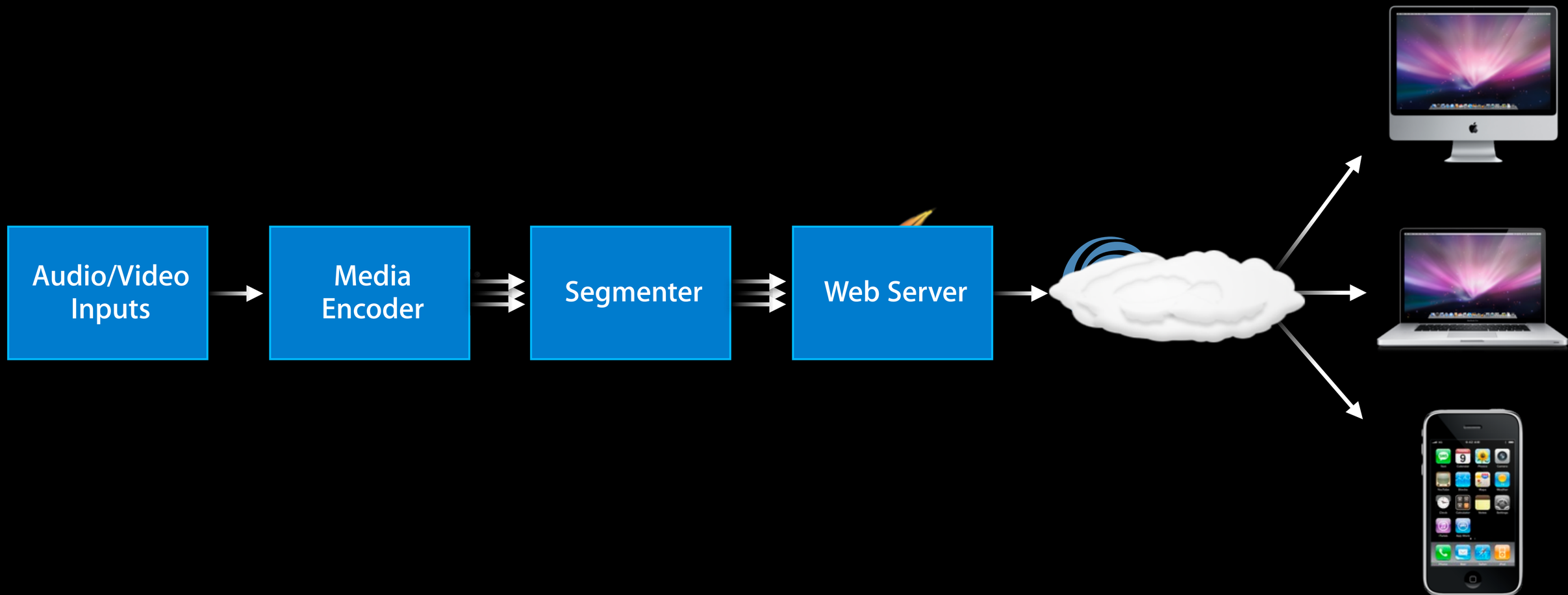
```
#EXTM3U
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=128000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=256000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=768000
http://example.com/hi.m3u8

#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=1500000,CODECS="avc1.77.40,mp4a.40.5"
http://example.com/main-profile.m3u8
```

Example Variant Playlist

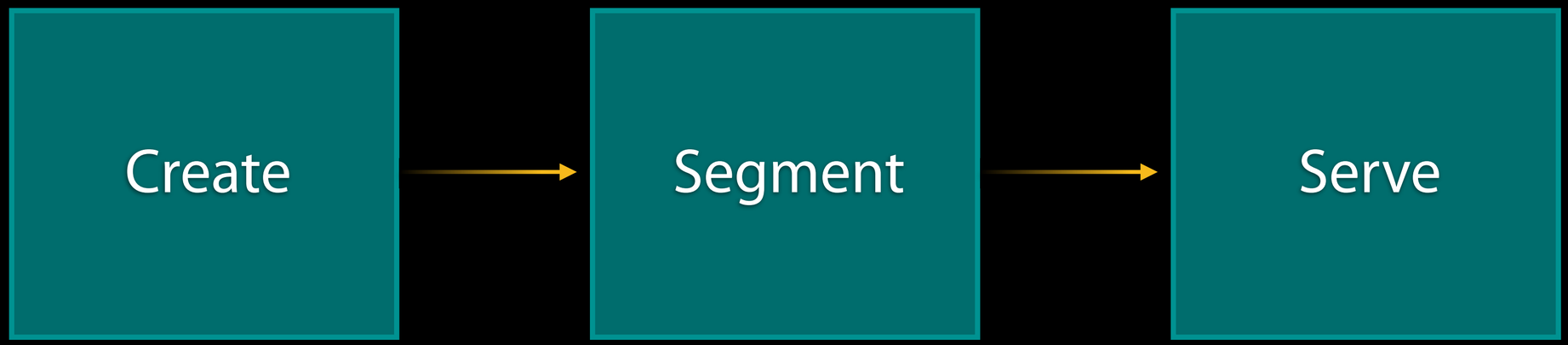
```
#EXTM3U
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=128000
http://example.com/low.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=256000
http://example.com/mid.m3u8
#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=768000
http://example.com/hi.m3u8

#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=1500000,CODECS="avc1.77.40,mp4a.40.5"
http://example.com/main-profile.m3u8

#EXT-X-STREAM-INF:PROGRAM-ID=1,BANDWIDTH=64000,CODECS="mp4a.40.5"
http://example.com/audio-only.m3u8
```

Demo

Demo Anatomy



Content Deployment



Create Your Stream

- Produce continuous MPEG-2 transport stream
- Hardware encoders available

Segment

- Choose on-demand or live
- Choose target duration (10 seconds)
- Choose number of segments in playlist (60 seconds or more)

Segmenter

- Apple mediastreamsegmenter
  - Consumes MPEG-2 TS from UNIX pipe or UDP socket
  - Produces segment files and playlist file
  - Cleans up expired segment files
  - Supports encryption
  - Can extract audio-only stream
- Draft specification available at ietf.org
  - http://tools.ietf.org/id/draft-pantos-http-live-streaming

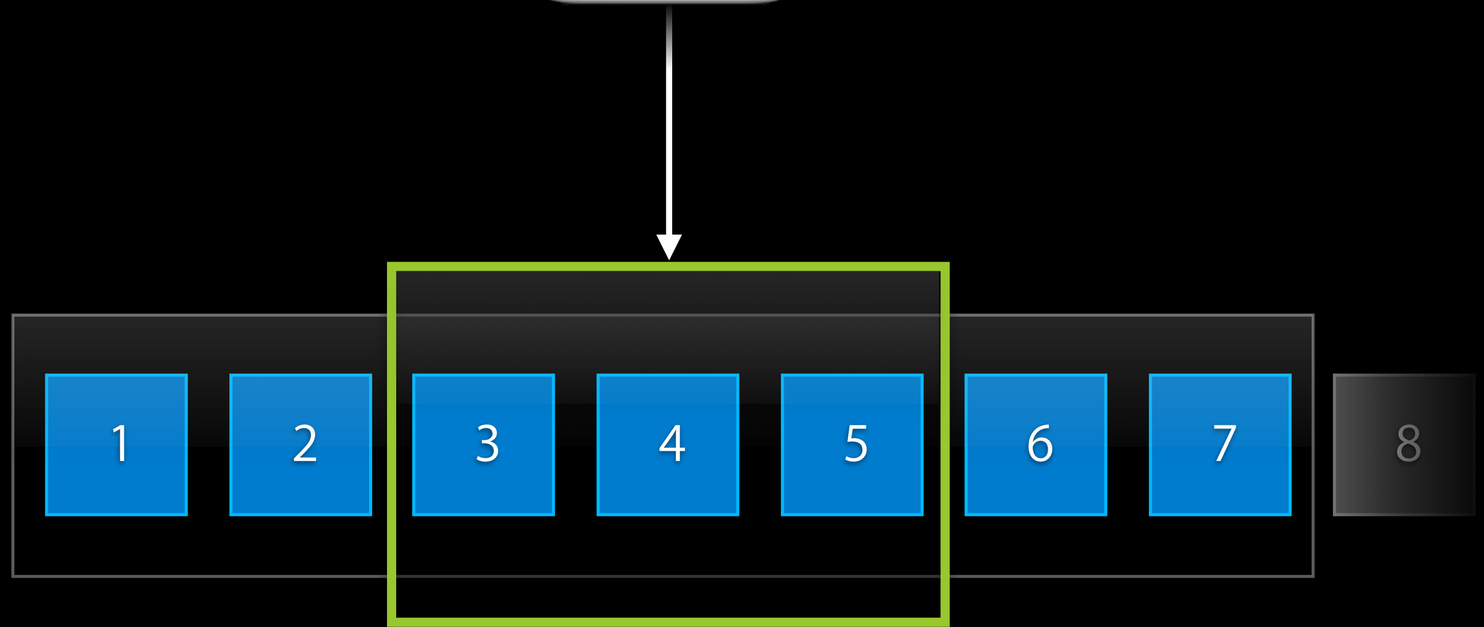
Serve

- Use standard HTTP servers
- Configure playlist file delivery
  - MIME type: application/x-mpegurl
  - Time to live: Target duration
- Control access to encryption keys
- Deploy to CDNs like any other files

highlight=3

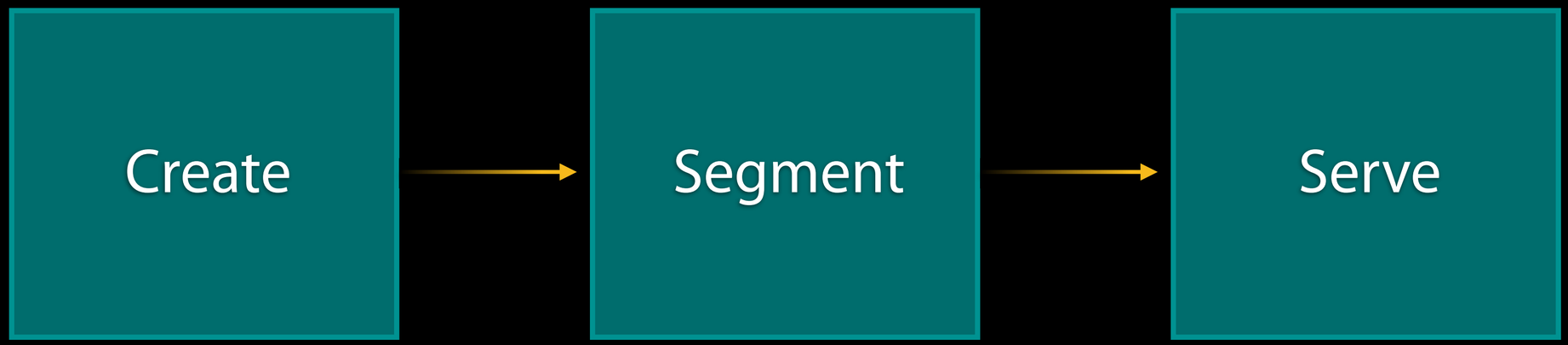
?highlight=3

highlight3.m3u8



highlight playlist

Content Deployment Recap



Summary

- Live content on iPhone and Snow Leopard
- Adapts to network conditions
- Standard media formats
- Scales cost effectively using familiar HTTP tools and software

- Public specification
  - http://tools.ietf.org/id/draft-pantos-http-live-streaming

Labs

HTTP Live Streaming Lab	Graphics and Media Lab B Wednesday 3:30PM

Q&A

WWDC Session Survey

You can rate your sessions on the WWDC Attendee Site.

Survey forms are located on each session description page at:

developer.apple.com/wwdc/attendee

WWDC09